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**The residual effectiveness of chlorhexidine gluconate 0.5% on vaccinating  
nurses hands during school vaccination programmes: A pilot study**

**A thesis presented in partial fulfilment of the requirements for the degree  
of  
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## Abstract

In the well-health community setting of school based student mass vaccination programmes (MVPs) the risks of cross-infection are not clear, as hand cleansing is not always practised between each injection administered by public health nurses (PHNs). This study provides evidence of the microbial colony forming units (CFUs) gathered from Auckland District Health Board's PHNs hand flora (finger-tip press on agar plates) during MVPs. The purpose of the study was to describe the antimicrobial residual efficacy over time of chlorhexidine gluconate 0.5%, a component of the alcohol-based hand gel (Sterigel+) used as a hand hygiene product at MVPs by PHNs. A non-experimental survey (pilot) design gathered vaccinators' palmar finger-tip skin flora prior to hand cleansing. Sampling was conducted over an eight week period at 17 schools settings from participating vaccinators at each programme. Hand flora were collected on 77 occasions ( $N = 154$  agar plate samples), from dominant and non-dominant hands and the CFUs reported by LabPlus.

No indications were found of a threshold to signify that chlorhexidine gluconate 0.5% was active up until a specific time and CFUs increased over the whole timeframe (5-90 minutes). A weak but significant correlation was found between the total CFUs and timeframe ( $r = 0.272$ ,  $p = 0.001$ ). Sixteen flora types were grown and formed into four microbial categories: skin flora (85% of all CFUs), Gram-negative flora (7%), environmental organisms (6%) and oral flora (2%). Potentially pathogenic flora were grown (*Staphylococcus aureus* occurring on 5% of samples and Gram-negative bacteria 17.5%). However, relatively few samples of highly pathogenic micro-organisms were culture positive and low CFU counts were identified. It was considered that, for healthy individuals, the cross infection risks presented were minimal. The vaccinators reasons to cleanse hands was strongly significant ( $p = 0.018$ ) with non-convenience CFUs being on average 88% higher than convenience CFUs at any particular time point. Hand dominance was shown not to be significant. The results of this study indicate that Sterigel+ does not provide ongoing antimicrobial protection beyond the quantified effects of an alcohol-based hand gel. Therefore, PHNs need to take this information into account when considering hand hygiene practice decisions related to cross infection risks during MVPs.

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## **Chapter One: Introduction and Overview of the Study**

### **1.1 Introduction**

The study was conducted at school mass vaccination programmes (MVPs) within Auckland District Health Board's (ADHB's) catchment area. This chapter provides background information for the thesis by offering a historical perspective of ADHB's student MVPs. An outline of the key points from the New Zealand Ministry of Health's (MOH's) guideline for appropriate vaccination processes will be given (MOH, 2006) in relation to ADHB's public health nurse (PHN) vaccinator practices. The principal issues identified by PHNs during the development of a hand hygiene protocol for MVPs are documented. The rationale for the study, the research question and study aims are presented along with an overview of each of the five thesis chapters. Finally a summary of this introductory chapter is provided.

### **1.2 Background to the study**

Somewhere in a New Zealand school this year a student will be vaccinated by a public health nurse. School based vaccination programmes may be part of the national childhood immunisation schedule or possibly organised in response to a MOH directive during a public health initiative such as the 2004-2005 Meningococcal B programme (see Appendix A). As authorised independent vaccinators PHNs are expected to follow the recommended New Zealand standards (MOH, 2006). The standards refer to vaccinators using aseptic techniques in the preparation and administration of vaccines along with knowing and observing standard safety guidelines, in order to minimise the risk of spread of infection (MOH, 2006). However, no recommendations or advice as to the frequency or type of hand cleansing regimes to be observed, at any vaccination occasion, are detailed in this handbook. Consequently, hand hygiene practices which are appropriate and feasible in community settings such as a school environment are not defined. This means that New Zealand PHNs do not have a specific evidence based guideline for best hand hygiene practice during MVPs.

School based vaccination programmes are organised and executed differently within each District Health Board area. Duffy (2002) conducted a mail survey of New Zealand District Health Boards PHNs hand cleansing practices at MVPs. Duffy found that hand hygiene protocols, products selection, and timeframes for product applications were not consistent between District Health Boards. The choice of cleansing methods was often left to the practitioner's discretion. Furthermore, via the survey comments section nurses requested information about suitable hand hygiene regimes for school MVPs (see Appendix B). Perhaps this request for appropriate cleansing methods was because school vaccination programmes differed markedly from vaccination processes that are followed within a doctor's surgery or a hospital setting. For instance, student MVPs performed in the school hall. So, to provide insight into ADHB's methods of organising MVPs an outline follows. The overview covers the relevant aspects (to this study) of PHN hand hygiene processes, vaccination practice and health status assessments for eligible students in a school setting.

### **1.3 Outline of school vaccination programmes**

#### **1.31 Health screening**

Students are screened on several junctures to ensure the MOH's criteria for receiving vaccinations are met (MOH, 2006). Firstly, as part of the consenting process, parents complete a written health survey. This information is reviewed and health issues are assessed by a designated PHN (attached to the school) who determines if the student has met the MOH's guidelines for inclusion in the school programme. Secondly, prior to immunisation the assigned vaccinator completes another health screen face to face with each consenting student to confirm immunisation eligibility or to withdraw the student from the MVP. For these reasons pupils who qualify for vaccination are considered to be in good health, and the clinical venue is regarded as being within a healthy community setting.

#### **1.32 Venues and programme routines**

Mass vaccination programmes are normally held in school halls, libraries or classrooms. A team of up to 18 nurses are rostered for each MVP and each nurse is allocated to specific

areas of responsibility. Furniture from within the school setting is utilised and other equipment is collated and then conveyed to each setting by the PHNs. The clinical working area for the programme is set up by the entire team, often using trestle tables as vaccinators' stations. Vaccines are transported and stored in chilly bins which each have a digital temperature display unit attached to them. A nurse is assigned to monitor and maintain the cold chain temperatures within the optimal vaccine storage range of 2-8°C (MOH, 2006). Prior to the programme beginning approximately 20 vaccines (per vaccinator) are collated by the PHN team, and placed in trays for distribution to each vaccination station. During the MVP other designated nurses continue to draw-up vaccines (to meet the numbers required on an ongoing basis).

A healthcare worker (known as a *floater*) ushers each student to a vaccinator station and this floater is available to support any student (usually by holding their hand) whilst the injection process occurs (see Appendix A). Programme schedules are planned on the basis of each vaccinator completing 20-25 immunisations per hour. Nurses assigned to the post-immunisation recovery venue are responsible for overseeing students during the time period following vaccination (20 minutes minimum). Prior to a student leaving the recovery setting (to resume school activities) a nurse will visually review each injection site (MOH, 2006). Through these processes students are either confirmed as well, or identified as requiring further medical attention.

### **1.33 Hand hygiene**

Before the commencement of the annual MVPs, an information session on hand hygiene methods is presented to PHNs by an infection control nurse or a medically accredited representative from the commercial company supplying the current hand cleansing agent. The update includes a practical demonstration of the recommended application regime for alcohol-based hand rubs followed by an update of product information. The next paragraph provides an outline of the MVP guideline's hand hygiene protocol which PHNs are expected to adhere to (see Appendix C).

On arrival at the venue PHNs cleanse their hands by either water based handwashing, or by

an antiseptic handrub with an alcohol-based hand gel. Nurses are required to cleanse their hands pre and post vaccine assembly, and the alcohol-based hand gel is reapplied prior to commencing vaccination. At the completion of the MVP either method of hand hygiene is repeated by all team members. However, PHN's may use their own discretion and decontaminate their hands at other times, as they consider necessary. Consequently, vaccinators' hands are not cleansed between each student's immunisation unless an occasion arises that each PHN individually determines necessitates decontamination. For example, if hands are coughed over then hand cleansing would be indicated (potential cross-infection risk). Vaccinators seldom have hand to hand contact with students, with direct contact limited to rolling up student's shirt sleeve to enable the vaccine to be injected correctly, for example into the deltoid muscle or subcutaneous tissue (see Appendix A). In fact, vaccinators frequently only have contact via their finger-tips during vaccine administration (syringe: dominant hand and student: non-dominant hand). Thus, it is only the injecting needle that is in contact with the vaccination site. If post-vaccination site bleeding occurs a cotton wool ball is directly applied to the area. The student will dispose of this item in a designated receptacle before leaving the recovery area.

## **1.4 Justification for the study**

### **1.41 Background to the public health nurse hand hygiene guideline**

School based vaccination programmes are frequently held in venues where access to handwashing facilities maybe difficult and the facilities themselves may be suboptimal for the MVP requirements. The timeframe available to PHN's for hand hygiene, in the context of a high work-load, is limited. The Immunisation Handbook's recommendation for using "...aseptic techniques in the preparation and administration of all vaccines..." (MOH, 2006, p. 403), have guided vaccinators' hand hygiene routines around the preparation of vaccines. However, both a PHN team leader and senior nurse commented from their MVP experience that PHNs have not performed hand hygiene routinely between vaccinating each student. Anecdotally no cross-infection issues have been identified by nurses or notified to ADHB from schools or parents following MVPs, even when water based handwashing was

the only method employed. Hence, it is not standard practise for vaccinators to cleanse hands between each student contact at MVPs because PHNs consider the risk of cross-infection to be low.

Prior to the introduction of a MVP hand hygiene guideline no formalised hand decontamination protocol had been adopted by PHNs for immunisation programmes. The routines and customs for managing student vaccinations and associated hand cleansing practices at MVPs were passed on orally within the nursing team. Benner (1984) maintains this handing down of knowledge from practice is embedded in nursing tradition. Regardless of these traditions, in 2001 PHNs voiced desires for an evidenced based cleansing strategy for MVPs that could be relied on to reduce the potential risk of cross-infection, to both student and vaccinator. In fact, the scope of practice for registered nurses requires the use professional nursing knowledge to provide skilled care, based on substantial scientific and well informed nursing judgement (Nursing Council of New Zealand, 2004).

#### **1.42 Background of the choice of hand hygiene regimes**

The potential for infection and cross-infection is an ever present concern in clinical healthcare. Evidence on how to reduce infection risk in hospitals is well documented for healthcare workers and for patients. Yet, in well-health non-acute community settings the risks are not clear. Besides there is a marked difference between community studies conducted for instance in long term residential situations, day care facilities or households compared to, community settings where nurses implement planned well-health initiatives.

Devising a suitable guideline for hand hygiene during MVPs (in the context of a busy vaccinating programme) was challenging for PHNs. Hospital infection control nurses were consulted and expertise sought from doctors within the University of Auckland's Medical School. Infection control nurses rely on the ADHB infection control manual which advocates hand cleansing between patients (ADHB, 2006). Remarks provided by two senior research doctors from the Auckland Medical School (with published hand hygiene studies) provided a different perspective. The risks of cross-infection at student vaccination programmes were considered minimal and more akin to a social handshake. This is because



students are regarded as well, only having brief contact with one vaccinator and slight direct skin-to-skin contact (see Appendix A). Thus, the hospital sourced recommendations (designed to prevent nosocomial infections) were regarded as neither transferable nor appropriate for the well-health community settings of school MVPs.

Nix (2000) recommends that the ideal hand hygiene regime should incorporate the latest scientific evidence and be based on intended users, the clinical aims and an understanding of ingredients. The idea that standard hospital hand hygiene recommendations apply in a situation more akin to social interactions caused much debate amongst PHNs during the creation of a suitable hand hygiene protocol for school MVPs. Regard was given to evidence gathered from the literature, university and hospital meetings and traditional ways of managing hand hygiene within the constraints of a school setting. Eventually a combination of practical and infection risk reducing solutions were agreed on. Subsequently, a draft MVP hand hygiene guideline (ADHB, 2002) was created to meet the PHNs aims of eliminating transient organisms and to reduce the level of contaminants acquired between hand hygiene episodes. The guideline employs standard handwashing (non-medicated liquid soap, water and paper drying method) and an alcohol-based hand gel 'Sterigel+'. Sterigel+ incorporates the antiseptic chlorhexidine gluconate (see Appendix D) for residual efficacy. It is the sustained broad spectrum anti-microbial activity of the chlorhexidine gluconate component that the hand hygiene guideline relies on to prevent the growth of bacteria thereby, providing ongoing protection against pathogenic colonisation and reducing the number of organisms acquired between hand cleansings.

During the literature search no reports of chlorhexidine gluconate's persistent or residual antimicrobial effects on hand flora within a community well-health clinical setting were located. Thus, safe nursing hand hygiene practice at MVPs could not be assumed. Denscombe (1998) advises potential researchers to consider what is already known about the research topic, the events to be studied, the range of people encompassed and what is likely to provide the best information. Therefore, after deliberation the most useful research vehicle was considered to be a descriptive survey to pilot tools and data collection methods, to provide PHNs with scientific evidence of chlorhexidine gluconate's antimicrobial action



from the community setting of a MVP.

### **1.5 Purpose of the study**

This study proposes to provide descriptive evidence from microbial data gathered from ADHB vaccinators hand flora following an application of hand hygiene product, Sterigel+ during the 2006 student MVPs.

#### ***Research question:***

- what is the residual effectiveness of chlorhexidine gluconate 0.5% on vaccinators hand flora?

#### ***Research aims:***

- to provide evidence on the efficacy of chlorhexidine gluconate 0.5% in a community healthcare setting over time.
- to quantify the numbers of microbial colony forming units (CFUs) found in a community healthcare setting as pilot information for future studies.
- to provide information on factors that may affect bacterial counts in a community healthcare setting, such as the time elapsed since cleansing hands.

This descriptive survey records the effect of Sterigel+ on ADHB's PHN vaccinators' hand flora at MVPs over time. The microbial flora gathered to represent hand flora was from the palmar surfaces of the vaccinating nurses' distal phalanges (i.e., finger-tip press onto agar plates). The results were reported to the researcher as raw data (by microbial flora types and CFU counts), from ADHB's laboratory provider (LabPlus). The vaccinators' reasons for hand cleansing, incidence of hand hygiene were collated separately by the researcher. Then, the information obtained classified and statistically examined, with the results presented through descriptive statistics. The potential benefits of the study include a greater scientific understanding of the process of skin decontamination and the information gained may be incorporated into evidence based hand hygiene practice. Additionally, this study may fill a gap identified in the literature, by providing new evidence in this specific setting on hand flora and chlorhexidine gluconate's action. Hence, the study will provide a scientific basis

for risk management strategies that aim to curb the occurrence of undesirable bacteria on vaccinators' hands and thereby reducing the risks of cross-infection.

## **1.6 Structure of the thesis**

The thesis is divided into five chapters: introduction, literature review, study design and methods, results and lastly discussion of findings and a recommendation.

### ***Chapter One: Introduction***

The introduction affords an overview of PHNs traditions, responsibilities and hand hygiene practices during New Zealand student school based MVPs. This chapter also presents the study's justification, purpose, aims and the research question formulated to provide descriptive evidence via a non-experimental survey.

### ***Chapter Two: Literature Review***

The literature review describes the processes taken to identify literature relevant to the risk of cross-infection, in the context of a MVP. This chapter provides and critiques a comprehensive range of literature related to the concept of microbial cross-infection, skin pathophysiology, skin infection, hand hygiene practices, hand cleansing products, the effects of hand hygiene practices (skin damage and skin moisture loss) and compliance to hand hygiene protocols.

### ***Chapter Three: Research Design and Methods***

The study design and methods chapter presents the theoretical framework and methodology and details the methods used to answer the research question. Included are ethical considerations and the study's approval pathways. Public health nurse participant recruitment, school contact approaches and the associated processes for consenting and consent withdrawal are detailed. The number of school settings where data gathering was performed and PHNs participation in the study are illustrated.

#### ***Chapter Four: Results***

Summaries from the data gathered are provided through descriptive statistics tables and figures. These particularise the microbial hand flora reported on by LabPlus, and comment on the pathogenicity of organisms reported. The microbial CFU counts over time are presented. The results also include the vaccinators' reasons for choosing to decontaminate hands, the associated timeframes for hand hygiene and data related to hand dominance.

#### ***Chapter Five: Discussion and Conclusions***

In this final chapter a discussion of the findings is presented and related to the research question and the aims of the study. The limitations and problems of the research process are acknowledged. Implications for nursing practice, education and research related to the study are commented on. A summary of the thesis is presented, then a concluding statement made, and lastly a recommendation for future research directions is offered.

### **1.7 Summary**

In New Zealand PHNs are required to offer immunisation to students through MVPs. These programmes are executed within school venues where access to suitable water hand hygiene facilities maybe difficult and vaccinators' workload index is high. It is not standard practise for vaccinators to cleanse hands between each student contact because in this healthcare setting PHNs consider the risk of cross-infection to be low. The alcohol-based and chlorhexidine gluconate hand gel (Sterigel+) is relied on to provide both immediate and residual antimicrobial efficacy. However, this type of product has not been reported in the literature from a community well-health setting and therefore, information on the hand gel's effectiveness is limited.

The study's findings will describe CFUs found on vaccinators hand flora during 2006 ADHB school vaccination programmes and may reveal whether the current PHN hand hygiene guideline is adequate to reduce the risk of pathogenic infections for both vaccinators and students. Alternatively, the evidence presented may alert PHNs of the need to revise hand cleansing practices at MVP. So, whatever the data reveals will provide new

information which may be reflected in the PHN hand hygiene guideline for MVPs. Thus, justification for this study has been shown and the purpose, research question and aims clearly stated. The following chapter overviews and critiques literature related to hand hygiene, skin pathophysiology and cross-infection.